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ABSTRACT

The present study examines the role of conceptual tempo on creativity and problem solving. It was hypothesized that reflective children would do well on tasks involving an evaluation component, while impulsive children would do well on typical creativity tasks. Measures of creativity, assessing fluency, flexibility, and originality, as well as measures of problem solving, stressing an evaluation component, were administered to 101 white suburban fifth grade children. Using MFF scores, four groups were identified: reflectives, impulsives, fast-accurates and slow-accurates. Results indicated no significant differences among the conceptual tempo groups on any of the creativity or problem solving tasks. It is suggested that conceptual tempo may be less effective in predicting differences in some aspects of cognitive functioning at this age. Examination of this hypothesis with younger children is recommended. (Author)

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RELATIONSHIP OF CHILDREN'S CONCEPTUAL TEMPO TO PROBLEM SOLVING AND CREATIVITY

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Relationship of Children's Conceptual Tempo to Problem Solving and Creativity

The study of cognitive style has continued to generate research for over a decade (See Kaufman, 1975, for a review of field independence-field dependence; Messer, 1974, for a review of reflection-impulsivity). One aspect of cognitive style which has been widely investigated is conceptual tempo, defined by Kagan (1973) as "the child's tendency to reflect upon the quality of a cognitive product" or to produce an "impulsive and unconsidered response" (p. 308). The existing literature (Kagan, 1965; Keogh & Donlon, 1972; Messer, 1970) suggests that there are favorable consequences on academic performance for being reflective, that is, tending to display slow response times in situations with high response uncertainty, as opposed to being impulsive, or tending to display fast response times in such situations. These favorable consequences exist even though there is some evidence that reflectives do not score much higher than impulsives on measures of intelligence (Ridberg, Parke, & Hetherington, 1971; Siegelman, 1969). A number of studies (Albert, 1969; Kagan, Pearson and Welch, 1966; Schwebel, 1966) have been directed toward increasing the reflectivity of children in the hope of increasing the academic achievement of the more impulsive child.

Nevertheless, questions have been raised as to whether there are situations in which an impulsive cognitive tempo would be advantageous. Wright (1974), for example, suggested that reflectives might be "generally less expressive and fluent in situations where uncritical productivity of ideas is required (p. 8)." The association theory of the creative process (Mednick, 1962; Wallach & Kogan, 1965) supports Wright's assumption. If ability to form novel combinations requires fluency, i.e., production of many responses, the stream of ideas should not be inhibited by the evaluative strategies that the reflective child might bring to the task. On the other hand, when the problem solving process does involve the quality of the product, i.e., an evaluative phase, the reflective child should be more effective. Therefore, the expectation might be that reflectives would not do as well on typical divergent thinking and creativity tasks as impulsives, for whom fluency and expressiveness might be more characteristic. However, the reflective child would do well on tasks involving an evaluation component.

There appears to be little evidence on the relationship of cognitive style to creativity and problem solving. Kaufman (1975) examined creative performance of eighth graders in relation to the variable of field-independence and field-dependence. Field independent subjects performed better on

the Torrance Tests of Creative Thinking, suggesting that independence of judgment and self directedness are important to creative expression. Bierbryer (1972) examined conceptual tempo on the MFF and fluency, flexibility, originality and elaboration, as measured by the Torrance, on a sample of Chinese-American children. He found no relationship between the two measures. Some research has been conducted on problem solving and conceptual tempo (Ault, 1973; Ault, Crawford & Jeffrey, 1972; McKinney, 1973). Generally, reflective children have been found to use more effective problem solving strategies.

The present research evaluates the creativity and problem solving skills of fifth grade children with different conceptual tempos. Measures of creativity were developed to assess fluency (capacity to generate a number of ideas in a given situation), flexibility (capacity to provide responses over a range of categories); and originality (statistically unique or unusual responses in population of responses). Several aspects of divergent thinking and creativity were identified from the work of Guilford (1967): 1) associational fluency; 2) expressional fluency; 3) word fluency; 4) adaptive flexibility; 5) ideational fluency; 6) spontaneous flexibility; and 7) originality. Measures of problem solving were selected which stressed the evaluation component. Evaluation involved using feedback to modify response selection in a sequence of

stages in solving a problem. It was hypothesized that impulsive children would produce superior responses on the creativity measures, especially fluency, while the reflective children would score significantly higher on the problem solving tasks.

METHOD

Subjects.

101 white, fifth-graders from four intact classrooms in a suburban community were involved in the present experiment. There were 42 boys and 59 girls. All of the children were from an upper-middle class background and all were of normal to above-average intelligence. The children were individually administered the Matching Familiar Figures Test (Kagan, 1965). The median time to the first response was 14.21 seconds; the median number of errors was 4.57. On the basis of the two medians, four groups were formed: impulsives, reflectives, fast-accurates, and slow-inaccurates.

Creativity Tasks and Procedures

Associational Fluency. Related Words-Children were asked to select a word associated in meaning to two other words, whose association with each other was not strong. This task was similar to that of the Remote Associates Test (Mednick, 1962). Children were to do as many of 15 of these problems as possible in 5 minutes.

Expressional Fluency. Making Sentences from Letters-Children were asked to make as many sentences in 7 minutes as

possible using four given letters as the first letters of the first four words in their sentence.

Word Fluency. Making Words from ANTELOPES-In 4 minutes, children were to generate as many English words, excluding proper names and abbreviations, as possible, using the letters of the word ANTELOPES.

Adaptive Flexibility. Making Boxes-Children were asked to cross out lines in a complex pattern of boxes (Matchsticks puzzles, Guilford, 1967) to reduce the number of boxes present, without any extraneous lines remaining. In 5 minutes, the children were to do as many of 6 of these tasks as possible.

Ideational Fluency, Spontaneous Flexibility and Originality. Running Short of Things and Uses for Plastic Trays-Children were asked to think of as many ways to conserve energy and natural resources in school or to reuse or use for other purposes small, clear plastic trays originally used by many supermarkets to hold meat cuts. For both of these tasks, however, in addition to a count of the number of ideas generated (Ideational Fluency), the ideas were categorized and a score of the number of different categories represented in subjects' answers was obtained (Spontaneous Flexibility). Finally, with the numbers of different types of responses categorized and tallied, a score was assigned to each response of every subject in terms of its originality, or infrequency in the population of total

responses. An average was obtained and a third score, Originality, was computed for each subject.

Problem Solving Tasks and Procedures

Verbal Maze. Children were asked to select pairs of "spy" names to make a chain to pass a message. The problem is that not every "spy" can speak to another "spy". Therefore, two scores were obtained from subjects: the number of correct paths identified and the number of dead-ends discovered.

The New Bike. In this simulated problem solving exercise, children were presented with a situation in which they had to earn enough money in a two week time period to buy an attractive bike on sale. Children could earn money by working for a variety of neighbors. However, not all jobs paid the same or took the same amount of time. The subject had to acquire a certain amount of information, evaluate it in terms of the goal or some plan of future behavior, and then act. Three scores were obtained: the amount of money earned, the number of days worked, and the amount of information acquired while working on the problem. Both simulation exercises and verbal mazes have had an extensive history (Davis, 1966).

Each of the creativity and problem solving tasks was administered to the children in their regular classrooms on a group basis. Interrater reliabilities were computed on the

scoring of the responses, and average interrater reliability was .91.

Teacher Ratings of Achievement

Finally, each teacher was asked to rate his or her students in terms of general school achievement on a seven point scale. The seven categories referred to the degree of success with regular school subjects.

7- Superior almost all the time

6- Above average in general

5- Average to above average most of the time

4- Average most of the time

3- Below average to average most of the time

2- Below average most of the time

1- Little success in any area

RESULTS

One way analyses of variance (Winer, 1971) were computed with the four levels of conceptual tempo, using the divergent thinking tasks, problem solving exercises, and teacher ratings as dependent variables. Only the teacher ratings analysis yielded a significant F-ratio. Post hoc (Winer, 1971) analyses indicated that the slow-inaccurates were perceived differently (less competent academically) from the other three groups of children. Table 1 presents a summary of the analyses with each of the dependent variables.

INSERT TABLE 1 ABOUT HERE

Table 2 presents the means and standard deviations for each group on each variable. No significant differences were found between the groups on any of the measures of creativity or problem solving. Note: Analysis of covariance was judged inappropriate because of the low correlations (less than .20) between the Ratings and the other measures.

INSERT TABLE 2 ABOUT HERE

DISCUSSION

The absence of differences among the four conceptual groups on the dependent variables, except for teacher ratings, may be interpreted in several ways. First, one can examine the instruments involved in the study. The measures of divergent and convergent thinking appeared appropriate for this age group, i.e., motivating and academically stimulating. The MFF distribution was a typical one (Messer, 1974), suggesting this group of children did not differ markedly from other groups of children this age on this task. However, the MFF has been criticized as an inadequate measure of reflection-impulsivity (Block, Block & Harrington, 1974). Block, Block and Harrington (1974) have in effect denied the construct validity of the MFF as a measure of reflection-impulsivity, commenting that a variety of alternative explanations may be

postulated for MFF results since they are neither a clear measure of response time nor accuracy, but a muddled combination of the two. Further, if the MFF measures response style in a situation where there is ambiguity in choice of a correct response, the measure may have no generalizability to the creative process, where there is no incorrect response and no ambiguity involved in choice selection. Yet the two problem solving tasks used in this study did require a correct response chosen from among alternatives, and no relationship was found here between these tasks and the MFF.

A second possible explanation for the non-significant findings could be the lack of control over the factor of intelligence, which it was not possible to control in this study. Teacher judgements were obtained, and did show that one group--the slow inaccurates--were perceived as less competent academically than the other groups. However, these children did not perform more poorly on the tasks in the study. This may indicate the relative independence of conceptual tempo from intellectual ability or the unique nature of the tasks in this study compared to the majority of school tasks. In any case, a review of the literature suggests that MFF scores do not simply reflect a difference in underlying intellectual capacity (Messer, 1974).

Perhaps the most interesting explanation for the lack of significant differences among the groups may be the age of the

sample. Many studies on conceptual tempo have used primary age children (Messer, 1974). It may be that conceptual tempo differences may be less effective in predicting certain task performance at the fifth grade level, i.e., while the children continue to vary along the impulsivity-reflectivity dimension measured by the MFF, the continuum may no longer portend important differences in some aspects of cognitive functioning. This would be comparable to the findings with preschool children, where differences in conceptual tempo do not seem to have the same relationship to other variables as for school age children (Kagan & Messer, 1975). Similarly, while McKinney (1973) found reflective second graders to be characteristically different and more efficient hypothesis testers, Ault et al (1972) found that reflective and impulsive third grade children did not differ in their basic scanning strategies, although the impulsives were less systematic. In a later study, Ault (1973) suggests that there is a "strong cognitive development component underlying reflection-impulsivity, especially at earlier grades" (p. 264). It is possible that by fifth grade, most of the children have achieved the basic cognitive level needed for solving the types of tasks presented in this study. While the MFF continues to differentiate relatively the groups of children, these differences may not be meaningful in terms of the tasks presented here.

It would seem important and reasonable to examine this hypothesis longitudinally to determine the developmental characteristics associated with MFF scores at different ages.

The results of this study do not lend themselves to concise interpretation. A replication of the study, with intelligence controlled more carefully and several age levels included, should be conducted before the question of the effect of conceptual tempo on creativity and problem solving is settled.

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Table 1

Summary of Analyses of Variance for All Variables

Dependent Variable	F	p
Associational Fluency	.40	n.s.
Word Fluency	1.50	n.s.
Expressional Fluency	1.43	n.s.
Adaptive Flexibility	1.36	n.s.
Ideational Fluency		
(Running Short of Things)	.07	n.s.
(Plastic trays)	1.22	n.s.
Spontaneous Flexibility		
(Running Short of Things)	.10	n.s.
(Plastic trays)	.40	n.s.
Originality		
(Running Short of Things)	.51	n.s.
(Plastic trays)	.26	n.s.
Verbal Maze		
(Spy - correct)	1.67	n.s.
(Spy - wrong)	1.88	n.s.
Problem-Solving Simulation		
(New Bike-Dollars)	1.24	n.s.
(New Bike-Information)	.71	n.s.
(New Bike-Days)	1.58	n.s.
General Achievement Ratings	4.00	.009

ariable		REF (N)	IMP (N)	FA (N)	SI (N)
ssociational luency	M	13.81 (31)	14.33 (33)	16.87 (15)	13.31 (16)
	SD	6.07	5.57	4.37	6.76
ord Fluency	M	4.64 (31)	4.91 (33)	5.87 (15)	5.75 (16)
	SD	2.65	3.03	3.07	4.18
xpressional luency	M	7.00 (21)	7.96 (23)	6.22 (9)	6.15 (3)
	SD	2.58	2.39	2.97	2.63
daptive lexibility	M	2.91 (32)	3.19 (32)	3.37 (16)	2.53 (15)
	SD	1.23	1.40	1.49	1.63
deational luency					
RST	M	5.86 (29)	5.53 (32)	5.79 (14)	5.71 (17)
	SD	2.51	2.08	2.14	3.14
Trays	M	7.75 (32)	7.18 (33)	8.37 (16)	9.37 (16)
	SD	4.10	3.20	4.01	4.36
pontaneous lexibility					
RST	M	3.03 (29)	3.06 (32)	3.21 (14)	3.06 (17)
	SD	1.22	1.09	.94	1.16
Trays	M	3.64 (31)	3.24 (33)	3.50 (16)	3.69 (16)
	SD	1.56	1.37	1.50	1.26
riginality					
RST	M	.88 (28)	.88 (32)	1.01 (14)	.96 (17)
	SD	.36	.40	.37	.45
Trays	M	.67 (30)	.61 (33)	.63 (15)	.58 (16)
	SD	.29	.33	.43	.34

Table 2 (continued)

Variable		REF (N)	IMP (N)	FA (N)	SI (N)
Verbal Maze					
Spy-correct	M	2.74(31)	3.52(33)	2.44(16)	2.67(15)
	SD	1.38	1.81	1.67	1.53
Spy-wrong	M	.68(31)	.97(33)	1.63(16)	1.13(15)
	SD	.96	1.24	1.90	1.20
Problem Solving Simulation					
New Bike-Days	M	9.97(30)	11.00(29)	8.69(16)	9.00(16)
	SD	3.68	4.25	3.84	2.26
New Bike-Dollars	M	29.53(30)	30.52(29)	27.38(16)	31.06(16)
	SD	7.87	6.12	6.47	3.83
New Bike-Information	M	16.43(30)	18.34(29)	17.56(16)	18.06(16)
	SD	4.70	4.51	4.61	3.63
General Achievement	M	4.81(32)	4.80(35)	4.94(17)	3.59(17)
	SD	1,24	1.45	1.70	1.65